PATENT ABSTRACTS OF JAPAN

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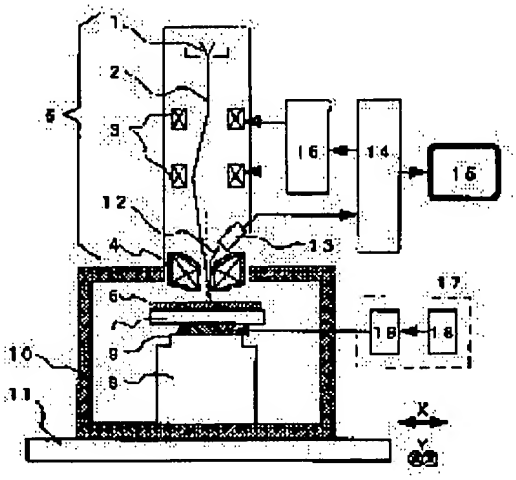
FUKUHARA SATORU

(54) CHARGED PARTICLE BEAM MICROSCOPE

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent a vibration from being generated on a scanning image on a monitor, by vibrating a sample by use of a piezoelectric actuator so as to cancel the resonance vibration of a stage or a mirror column.

SOLUTION: A drive signal having an optional frequency component is imparted to a piezoelectric actuator 9 to vibrate a sample 6, whereby the vibration generated on a scanning image on a monitor is canceled. A small-sized piezoelectric actuator 9 having a sufficiently high resonance frequency to a stage 8 or a mirror column 5 is provided between the stage 8 and a sample holder 7, and the sample holder 7 is driven at a frequency conformed to the resonance frequency of the stage 8 or the mirror column 5, whereby the relative position of the sample 6 and a scanning electron beam 2 is corrected. The amplitude and phase of the drive signal are controlled while observing the image displayed on a monitor 15. Thus, the vibration generated when a disturbance having a complicated phase such as noise is inputted can be easily corrected.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] The charged-particle line microscope characterized by providing the following. The source of a charged particle which generates a charged-particle line. Deflecting system which makes the above-mentioned charged-particle line scan on a sample. The mirror body column which consists of electron optics systems of the objective lens as which the above-mentioned charged-particle line is completed on the above-mentioned sample. The stage which moves the sample electrode holder and the above-mentioned sample which fix the above-mentioned sample to arbitrary positions, rotates, and is made to incline, In the charged-particle line microscope which detects the sample room which built in the above-mentioned stage, the secondary charged particle generated by irradiation of the above-mentioned charged-particle line to the above-mentioned sample top, a transparency charged particle, a reflective charged particle, etc., and observes the above-mentioned detecting signal as a picture with a monitor vibration generated on a picture -- an amendment -- the function to make a sample drive like
[Claim 2] The charged-particle line microscope which drives the above-mentioned sample electrode holder according to claim 1 while controlling frequency, an amplitude, and a phase using an electrostrictive actuator.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to a charged-particle line microscope.
[0002]
[Description of the Prior Art] The composition of a charged-particle line microscope is shown in drawing 2 by making an electron microscope into an example. By drawing 2 , the longitudinal direction of space is defined as the direction of X, and the cross direction is defined as the direction of Y. It deviates in X and the direction of Y with the deflecting system 3 installed in the mirror body column 5, and is completed as the front face of a sample 6 by the electron optics system of objective lens 4 grade, and the electron ray 2 generated from the electron gun 1 is irradiated, scanning sample 6 front face. Here, the input current of X and the deflecting system 3 of Y each direction is given by the scanning current source 16, and each scanning current is controlled by the control unit 14. Moreover, it is fixed to the sample electrode holder 7, and a sample 6 is movable to arbitrary positions further with the stage 8 with the function of horizontal displacement, an inclination, and rotation. The mirror body column 5 and the stage 8 are being fixed to the sample room 10. Furthermore, the sample room 10 is being fixed to the base plate 11 through the direct or vibrationproofing implement. The secondary electron 12 generated when an electron ray 2 is irradiated by the sample 6 is detected by the secondary electron detector 13, and the scanning picture of sample 6 front face is formed in a monitor 15.
[0003]
[Problem(s) to be Solved by the Invention] With conventional charged-particle line equipment, when it installs in the place where the noise of a chip fabrication factory clean room etc. is big, vibration appears in a scanning picture. When the sound pressure of noise inputs into the front face of the sample room 10, this vibration vibrated the sample room 10 slightly, and in order that this slight vibration may resonate a stage 8, it is generated. Or when sound pressure inputs into the mirror body column 5 and the mirror body column 5 resonates, it generates in order to vibrate an electron source 1. Since the direct input of the sound pressure of the noise mentioned above is carried out to the sample room 10 and the mirror body column 5, it is difficult to attenuate vibration using a mechanical attenuator. In order to attenuate vibration generated with sound pressure, the whole equipment is formed for a wrap barrier wall and the sample room 10, a wrap noise insulation board is formed for the mirror body column 5, and the method of attenuating the sound pressure of the noise inputted into equipment is proposed (Japanese Patent Application No. No. 245762 [seven to]).
[0004] However, the oscillation frequency of the scanning picture which poses a problem is 50-300Hz low frequency which is the resonance frequency of a stage 8. In order to decrease the noise of this low frequency, and for a sample room not to vibrate completely and to carry out, large-scale equipments, such as a wrap barrier wall, are completely needed in equipment, and realization is actually difficult.
[0005] The purpose of this invention offers the electron microscope vibration is made not to appear in a scanning picture, without using a large-scale barrier wall etc.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it is made for vibration not to appear in the scanning picture displayed on a monitor 15, even if a stage 8 and the

mirror body column 5 resonate, when this invention solves that vibration which appears in a scanning picture is resonance of a stage 8 and the mirror body column 5. When a stage 8 and the mirror body column 5 do not resonate, a stage 8 and the mirror body column 5 vibrate to the sample room 10 and one, and vibration does not appear in a scanning picture. However, since vibration of a stage 8 becomes large to vibration of the sample room 10 and the mirror body column 5 when a stage 8 resonates, vibration will appear in a scanning picture. On the other hand, since the scanning electron ray 2 vibrates relatively to a sample 6 when the mirror body column 5 resonates, vibration appears in a scanning picture. even while the stage 8 and the mirror body column 5 are resonating, the relative position of a sample 6 and the scanning electron ray 2 does not vibrate -- as -- an amendment -- if things are made, cannot appear vibration and it can be carried out to a scanning picture

[0007] this invention is an amendment thing about the relative position of a sample 6 and the scanning electron ray 2 by forming the small electrostrictive actuator 9 which had sufficiently high resonance frequency to the resonance frequency of a stage 8 or the mirror body column 5 between a stage 8 and the sample electrode holder 7, and driving the sample electrode holder 7 on the frequency which was in agreement with the resonance frequency of a stage 8 or the mirror body column 5. vibration generated when disturbance with complicated phases, such as noise, inputs, since the amplitude of the driving signal at this time and the phase were controlled observing the picture displayed on a monitor 15 -- easy -- an amendment -- things are made

[0008]

[Embodiments of the Invention] The electronic instrument of drawing 1 is used for an example, and the example of this invention is explained. By drawing 1 , the longitudinal direction of space is defined as the direction of X, and the cross direction is defined as the direction of Y. An electron gun 1, deflecting system 3, and the mirror body column 5 that consists of electron optics systems of objective lens 4 grade are being fixed to the upper surface of the sample room 10. The electron ray 2 generated with the electron gun 1 is deflected in X and the direction of Y by deflecting system 3, scans sample 6 front face, detects the secondary electron 12 generated at this time by the secondary electron detector 13, and forms the scanning picture of sample 6 front face in a monitor 15 by the control circuit 14. The stage 8 is fixed and built in the inferior surface of tongue of the sample room 10. The sample 6 is being fixed to the sample electrode holder 7. Furthermore, the sample electrode holder 7 is attached in the stage 8 through the electrostrictive actuator 9. Here, it has the function which a stage 8 moves a sample 6 to arbitrary positions, rotates it, and is made to incline. Furthermore, an electrostrictive actuator 9 is driven by the signal generating circuit 18 and the drive control circuit 17 which consists of sources 19 of driver voltage. The drive control circuit 17 has the function to vibrate a sample 6 and the sample electrode holder 7 with X, frequency arbitrary in the direction of Y, an amplitude, and a phase.

[0009] In this invention, vibration generated by the scanning picture on a monitor 15 is offset by giving the driving signal which had arbitrary frequency components in the electrostrictive actuator 9, and vibrating a sample 6. Here, a driving signal is outputted from the drive control circuit 17. Here, in the signal generating circuit of the drive control circuit 17, the frequency of a driving signal, an amplitude, and a phase can be set up arbitrarily. Here, although a driving signal is set up so that vibration of the scanning picture on a monitor 15 may become the minimum, the frequency is in agreement with the resonance frequency of a stage 8 or a mirror body column. In addition, the electrostrictive actuator used by this example has sufficiently high resonance frequency to the resonance frequency of a stage 8 and the mirror body column 5.

[0010] In this example, since the wave of a driving signal can be set up arbitrarily, when the resonance frequency of a stage 8 changes and the frequency of picture vibration changes by movement of a stage 8, the inclination, etc., it can respond. Moreover, picture vibration generated when disturbance with unstable phases, such as noise, inputs can also be offset by changing the phase of a driving signal at any time.

[0011]

[Effect of the Invention] Since the sample is vibrated by the electrostrictive actuator so that resonance vibration of a stage 8 or the mirror body column 5 may be offset, vibration stops appearing in the scanning picture on a monitor in this invention.

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TECHNICAL FIELD

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PRIOR ART

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MEANS

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Explanatory drawing of the example of this invention.
[Drawing 2] Explanatory drawing of the conventional electron microscope.
[Description of Notations]
1 -- electron gun and 2 -- -- a scanning electron ray, 3 -- deflecting system, 4 -- objective lens, and 5 -- -- a mirror body column, 6 -- sample, 7 -- sample electrode holder, and 8 -- -- a stage, 9 -- electrostrictive actuator, 10 -- room, and 11 -- -- a base plate, 12 -- secondary electron, 13 -- secondary electron detector, and 14 -- -- a control unit, 15 -- monitor, 16 -- scanning current source, and 17 -- -- a drive control circuit, 18 -- signal generating circuit, and the source of 19 --

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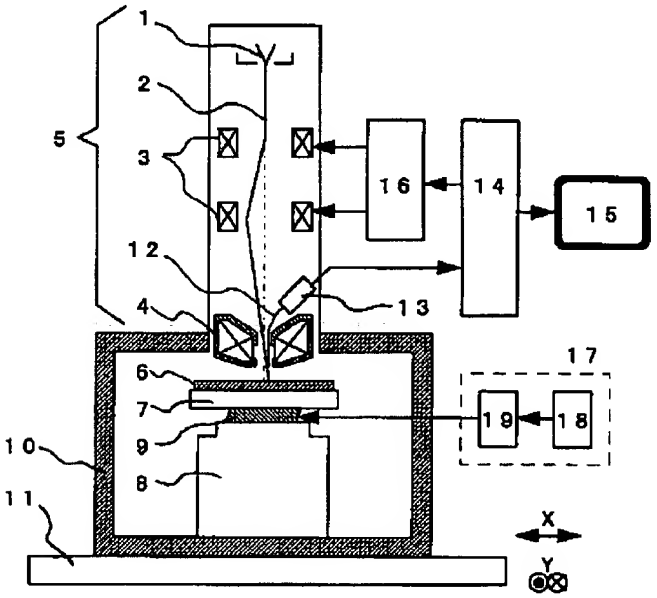
DRAWINGS

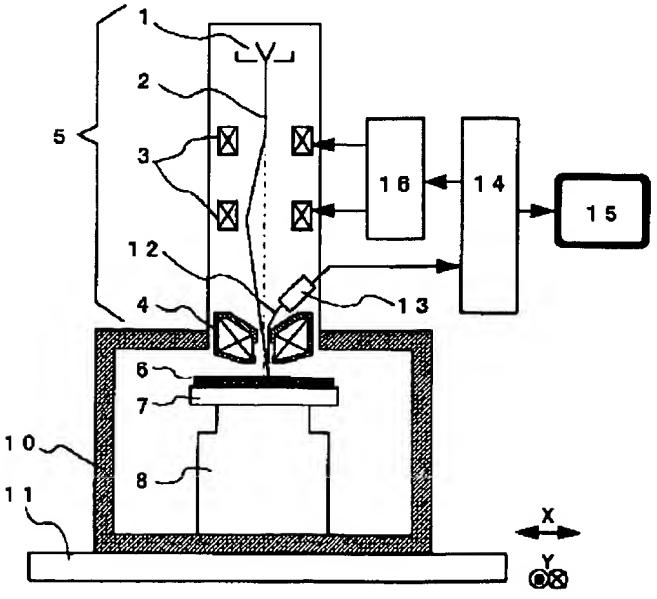
[Drawing 1]

図 1



[Drawing 2]

図 2



[Translation done.]

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審査請求　未請求　請求項の数2　ＯＬ　（全 3 頁）

(21)出願番号　特願平9－105687

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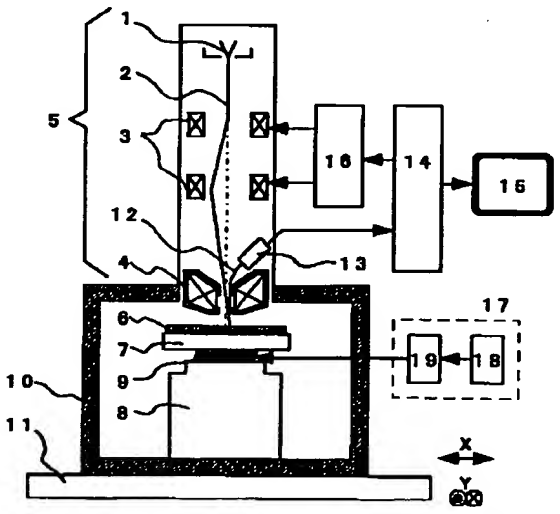
(74)代理人　弁理士　小川　勝男

(54)【発明の名称】　荷電粒子線顕微鏡

(57)【要約】
【課題】従来の荷電粒子装置を騒音の大きな場所に設置した時、その音圧を受けてステージや鏡体カラムに共振し、その結果、走査画像に振動が現れてしまう。
【解決手段】共振周波数の十分高い圧電アクチュエータをステージと試料ホルダとの間に設置して、ステージや鏡体カラムの振動を補正するように試料を振動させる。

図 1



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【特許請求の範囲】

【請求項1】荷電粒子線を発生する荷電粒子源と、上記荷電粒子線を試料上で走査させる偏向器と、上記荷電粒子線を上記試料上で収束させる対物レンズの電子光学系とから構成される鏡体カラムと、上記試料を固定する試料ホルダ、上記試料を任意の位置に移動，回転，傾斜させるステージ、上記ステージを内蔵した試料室、上記試料上への上記荷電粒子線の照射により発生した二次荷電粒子，透過荷電粒子、及び反射荷電粒子等を検出し、上記検出信号をモニタで画像として観察する荷電粒子線顕微鏡において、画像上に発生する振動を補正するように、試料を駆動させる機能を有することを特徴とする荷電粒子線顕微鏡。

【請求項2】請求項1に記載の上記試料ホルダを圧電アクチュエータを用いて周波数，振幅、および位相を制御しながら駆動する荷電粒子線顕微鏡。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は荷電粒子線顕微鏡に関する。

【０００２】

【従来の技術】荷電粒子線顕微鏡の構成を電子顕微鏡を一例として図２に示す。図２で紙面の左右方向をＸ方向，前後方向をＹ方向と定義している。電子銃１から発生された電子線２は鏡体カラム５に設置された偏向器３によりＸ，Ｙ方向に偏向され、対物レンズ４等の電子光学系により試料６の表面に収束され、試料６表面を走査しながら照射する。ここで、Ｘ，Ｙ各方向の偏向器３の入力電流は走査電流源１６により与えられ、各々の走査電流は制御装置１４により制御される。また、試料６は試料ホルダ７に固定され、更に、水平移動，傾斜，回転の機能を持ったステージ８により任意の位置に移動することができる。鏡体カラム５およびステージ８は試料室１０に固定されている。更に、試料室１０はベースプレート１１に直接あるいは防振具を介して固定されている。電子線２が試料６に照射される時に発生する二次電子１２は二次電子検出器１３で検出され、モニタ１５に試料６表面の走査画像が形成される。

【０００３】

【発明が解決しようとする課題】従来の荷電粒子線装置では半導体工場クリーンルーム等の騒音が大きな場所に設置した時に走査画像に振動が現れる。この振動は騒音の音圧が試料室１０の表面に入力した時、試料室１０をわずかに振動させ、このわずかな振動がステージ８を共振させるために発生している。あるいは、音圧が鏡体カラム５に入力し鏡体カラム５が共振した時、電子源１を振動させるために発生する。上述した騒音の音圧は試料室１０、及び鏡体カラム５に直接入力するので、機械的な減衰器を用いて振動を減衰させることは困難である。音圧により発生する振動を減衰させるため、装置全体を

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覆う防音壁や、試料室１０，鏡体カラム５を覆う遮音板を設け、装置に入力する騒音の音圧を減衰させる方法が提案されている（特願平7－245762号）。

【０００４】しかし、問題となっている走査画像の振動周波数はステージ８の共振周波数である５０～３００Ｈｚの低周波である。この低周波の騒音を減衰し、試料室が完全に振動しなくするためには、装置を完全に覆う防音壁等の大掛かりな装置が必要となり、現実的には実現が困難である。

【０００５】本発明の目的は、大掛かりな防音壁などを用いることなしに、走査画像に振動を現れないようにする電子顕微鏡を提供する。

【０００６】

【課題を解決するための手段】上記課題を解決するため、本発明は走査画像に現れる振動がステージ８、及び鏡体カラム５の共振であることを解明することにより、ステージ８，鏡体カラム５が共振しても、モニタ１５に表示される走査画像には振動が現れないようにしたものである。ステージ８，鏡体カラム５が共振しない場合には、ステージ８と鏡体カラム５は試料室１０と一体に振動し、走査画像には振動が現れない。しかし、ステージ８が共振する場合は、ステージ８の振動は試料室１０，鏡体カラム５の振動に対して大きくなるので、走査画像に振動が現れてしまう。一方、鏡体カラム５が共振した時は、走査電子線２が試料６に対して相対的に振動してしまうことから、走査画像に振動が現れる。ステージ８、及び鏡体カラム５が共振している時でも、試料６と走査電子線２の相対的な位置が振動しないように補正することができれば、走査画像に振動を現れなくすることができる。

【０００７】本発明はステージ８や鏡体カラム５の共振周波数に対し十分高い共振周波数を持った小型の圧電アクチュエータ９を、ステージ８と試料ホルダ７の間に設け、試料ホルダ７をステージ８あるいは鏡体カラム５の共振周波数と一致した周波数で駆動することにより試料６と走査電子線２の相対的な位置を補正するものである。この時の駆動信号の振幅，位相はモニタ１５に表示される画像を観察しながら制御するので、騒音等の位相が複雑な外乱が入力した時に発生する振動も容易に補正することができる。

【０００８】

【発明の実施の形態】本発明の実施例を図１の電子装置を例に用いて説明する。図１で紙面の左右方向をＸ方向，前後方向をＹ方向と定義している。電子銃１，偏向器３，対物レンズ４等の電子光学系から構成される鏡体カラム５は試料室１０の上面に固定されている。電子銃１で発生した電子線２は偏向器３によりＸ，Ｙ方向に偏向され、試料６表面を走査し、この時に発生する二次電子１２を二次電子検出器１３で検出し、制御回路１４によりモニタ１５に試料６表面の走査画像を形成してい

る。ステージ8は試料室10の下面に固定され、内蔵されている。試料6は試料ホルダ7に固定されている。更に、試料ホルダ7は圧電アクチュエータ9を介してステージ8に取り付けられている。ここで、ステージ8は試料6を任意の位置に移動，回転，傾斜させる機能を有している。更に、圧電アクチュエータ9は信号発生回路18，駆動電圧源19より構成される駆動制御回路17により駆動される。駆動制御回路17は試料6及び試料ホルダ7をX，Y方向に任意の周波数，振幅，位相で振動させる機能を有している。

【0009】本発明では圧電アクチュエータ9に任意の周波数成分を持った駆動信号を与え、試料6を振動させることにより、モニタ15上の走査画像で発生している振動を相殺している。ここで、駆動信号は駆動制御回路17から出力される。ここで、駆動制御回路17の信号発生回路では駆動信号の周波数，振幅，位相を任意に設定することができる。ここで、駆動信号はモニタ15上の走査画像の振動が最少になるように設定されるが、その周波数はステージ8または鏡体カラムの共振周波数と一致している。なお、本実施例で使用される圧電アクチュエータはステージ8および鏡体カラム5の共振周波数に対して十分高い共振周波数を持つものである。

【0010】本実施例では駆動信号の波形は任意に設定

することができるので、ステージ8の移動，傾斜等により、ステージ8の共振周波数が変わり、画像振動の周波数が変わる場合も対応することができる。また、騒音等の位相が不安定な外乱が入力した時に発生する画像振動も、駆動信号の位相を随時変化させることにより相殺することができる。

【0011】

【発明の効果】本発明ではステージ8または鏡体カラム5の共振振動を相殺するように試料を圧電アクチュエータにより振動させているので、モニタ上の走査画像には振動が現れなくなる。

【図面の簡単な説明】

【図1】本発明の実施例の説明図。

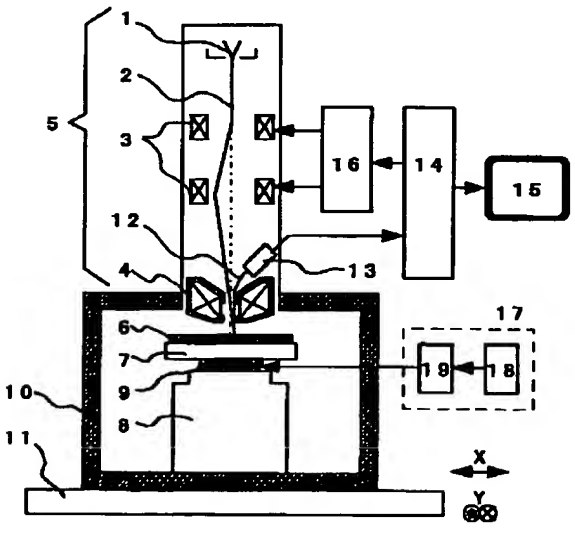
【図2】従来の電子顕微鏡の説明図。

【符号の説明】

1…電子銃、2…走査電子線、3…偏向器、4…対物レンズ、5…鏡体カラム、6…試料、7…試料ホルダ、8…ステージ、9…圧電アクチュエータ、10…室、11…ベースプレート、12…二次電子、13…二次電子検出器、14…制御装置、15…モニタ、16…走査電流源、17…駆動制御回路、18…信号発生回路、19…駆動電圧源。

【図1】

図 1



【図2】

図 2